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Endovascular repair of traumatic aortic injury in a 16 month old

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ABSTRACT

Traumatic injury to the thoracic aorta is rare in children. We present the youngest reported case of traumatic thoracic aortic injury, occurring in a 16 month old (10 kg) male. Management emphases include identification and stabilization of all injuries, blood pressure control, timely repair of the aortic injury, and long-term radiographic follow-up. We demonstrate that endovascular repair at this age is feasible, but considerations such as small vessel diameter and patient growth may limit broad application. Long-term outcomes research in this population is necessary.

Traumatic injury is the most common cause of death in the pediatric population, yet traumatic injury to the thoracic aorta is rare. About 0.1% of all cases of pediatric blunt trauma presenting to the emergency department are diagnosed with thoracic aortic injury [1]. Those children who do present with this injury are usually older. The mortality rate remains high at around 41% in 6–17 year old children [1]. We present the youngest reported case of traumatic thoracic aortic injury, describe the management of this patient, and review the relevant literature.

1. Case report

A 16 month old male weighing 10 kg was brought in by ambulance to the Children's Hospital Colorado Emergency Department after a trailer tire had rolled over the top of his chest. He had been unconscious at the scene with shallow respirations and was seen moving all extremities with the exception of his left upper extremity. In the emergency department, physical exam was notable for tachycardia with normotension, a left upper extremity bony deformity and scattered abrasions. Radiologic assessment included trauma series radiographs and a CT scan of the chest, abdomen and pelvis. Identified injuries included three right-sided rib fractures, a left-sided pulmonary contusion, small bilateral pneumothoraces and fractures of the left humerus. CT angiogram (CTA) of the chest revealed an intramural hematoma of the descending thoracic aorta distal to the left subclavian artery at the level of the left mainstem bronchus (Figs. 1 and 2).

The trauma surgery service assumed primary management of the patient. After immobilizing the left upper extremity and stabilizing the patient in the pediatric intensive care unit, interventional cardiologists were consulted. A nicardipine infusion was initiated for blood pressure management, titrating to a mean arterial blood pressure of 55–65 mm Hg with the goal of avoiding hypertension while maintaining adequate end organ perfusion. A norepinephrine infusion was required intermittently to maintain mean arterial blood pressures within this range. Six hours after presentation, the patient was transferred to the cardiac catheterization suite for stenting of the aortic injury. A 7 French access port was placed via a right common femoral artery cut-down. Three iCAST stent grafts (Atrium Medical Corp, Hudson, NH), measuring 16, 22, and 22 mm respectively, mounted on an OptaPro balloon (Cordis Corp, Bridgewater, NJ) were deployed at 7–8 mm Hg in an overlapping fashion to exclude the aortic injury. Completion angiography confirmed laminar flow with exclusion of the intimal flaps. The patient began a 40.5 mg aspirin daily regimen for maintenance of stent patency. Due to the small diameter of the common femoral artery in this 16 month old, the perfusion to the right lower extremity was closely monitored. The patient maintained equal pulses and brisk capillary refill to his bilateral lower extremities. The

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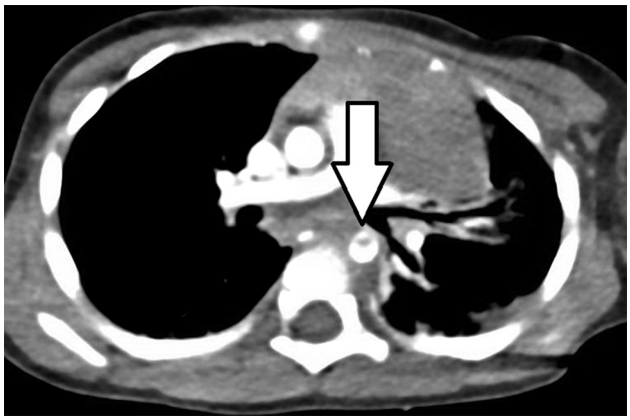

Fig. 1. Screening axial CT with intravenous contrast. The arrow marks the location of aortic injury.

patient's stay was complicated by polymicrobial pneumonia, likely due to aspiration at the time of injury. This was adequately treated with a two week broad-spectrum antibiotic regimen. On post-procedure day 3, a CTA was performed, confirming absence of an endoleak or other complication (Fig. 3). The patient was then extubated and transferred out of the intensive care unit.

The patient was discharged home on hospital day 11 and was instructed to continue taking a unit dose of 40.5 mg chewable aspirin daily. At his one month outpatient follow-up, he was completely asymptomatic. A screening echocardiogram confirmed continued laminar flow through the aorta. There was no blood pressure gradient across the stent as measured from his right upper extremity to his bilateral lower extremities. He maintained strong pulses in his right lower extremity. He will follow up in 6 months with a screening CTA, followed by yearly CTA screens until intervention is felt to be necessary. Eventually the patient will outgrow the stents, requiring a dilation procedure. However, it is likely that the plastic stent covering will limit the ability to reach full adult diameter, at which point he will require open surgical intervention.

Fig. 2. Screening sagittal CT with intravenous contrast. The arrow marks the location of aortic injury.

Fig. 3. Follow-up CT angiogram reconstruction of the stents confirming absence of endoleak.

2. Discussion

At the age of 16 months, this is the youngest reported patient with traumatic thoracic aortic injury. There is one other reported case of a traumatic aortic injury in a 16 month old, in the abdominal aorta, which was managed nonoperatively [2].

In the pediatric population, aortic dissection may be more commonly caused by trauma than connective tissue disorders, contrary to what was previously believed. A retrospective analysis of 45 pediatric cases of aortic dissection over a 10 year period revealed that 42% were caused by trauma, compared to only 24% by connective tissue disorders [3]. Most of these traumatic aortic injuries were sustained during motor vehicle collisions [4,5].

The mechanism of injury of blunt aortic injury in the pediatric population is most commonly rapid deceleration, but can also be caused by blast force, or in this case, by compression [3,6]. Children may be more protected against traumatic aortic injury compared to adults due to their more elastic vessel walls [1]. However, their chest walls are notably more compliant which may allow a crush injury of sufficient force to damage the aorta.

Important considerations in the management of these patients are tight blood pressure control, management of associated injuries and timely repair of the aortic disruption. Unfortunately, pediatric guidelines for an optimal blood pressure range in aortic injury do not exist. For older pediatric patients, adult guidelines have been successfully applied [4] but the ideal blood pressure range must take into account the patient's appropriate vitals for age and must balance maintaining end-organ perfusion with avoiding hypertension. Pulmonary contusions are present in up to 55% of these cases [1], likely due to increased chest wall compliance [7] so adequate ventilation and pneumonia prevention strategies must be maintained. If aortic repair is indicated, it should be performed at the earliest time it is safe to do so. Timing of repair may be delayed, for instance, by active hemorrhage or central nervous system injury.

Aortic repair options include open primary repair, open stent placement, endovascular stent placement, or nonoperative medical management. Our case demonstrates that endovascular repair is feasible even at 16 months of age. The decision to pursue this intervention must be balanced against the risks of long-term radiation exposure involved in patient follow-up [4] as well as the

need for future stent exchange or removal. Pediatric endovascular repair has previously been pursued with the belief that adults are better operative candidates for open procedures than children [7]. By this reasoning, the endograft becomes a bridge to open surgery once the patient outgrows the stent. A deliberate oversizing of the stent upon endovascular placement may allow for future dilations [8] but this has not yet been shown to avoid the need for future operative stent exchange. Endovascular repair must account for the smaller vessel diameter in children which could be occluded by the access sheath. Some authors have felt that a pediatric femoral vessel may be too small to safely access [9]. For example, a right femoral cutdown during endovascular repair led to an ischemic right foot in a 10 year old [6]. However, a 6Fr access sheath has been used in a 9 year old with abdominal aortic injury without distal extremity complication at 12 months follow up [10].

Despite the early promise shown by pediatric endovascular repair, open repair remains the standard of care [9]. Like endovascular repair, operative repair will similarly require reoperation for stent exchange once the patient has grown unless primary repair is able to be performed. Therefore, because of the potential to avoid a future major operation, primary repair is ideal if possible [10]. Other considerations when deciding to perform open repair include the requirements of cardiac bypass and heparin which may be contraindicated depending on the associated injuries [7]. Finally, intimal flap tears and pseudoaneurysms have been successfully managed nonoperatively when followed out to 16 months post-injury [5] but medical management must be weighed against the risk of aortic rupture or progression of the dissection flap and end organ ischemia.

3. Conclusion

In summary, traumatic thoracic aortic injury is rare in children and its management is complex, especially when combined with other injuries. Our case report suggests that endovascular repair is feasible in patients as young as 16 months of age. The decision to pursue this management must be weighed against the risks and benefits of operative stenting, primary repair, and medical management. Long-term follow-up is required and future operations may be needed as the child grows. Due to the unknown course of these patients as they grow into adulthood, long-term outcomes research in this population is necessary.

References

[1] Heckman SR, Trooskin SZ, Burd RS. Risk factors for blunt thoracic aortic injury in children. J Pediatr Surg 2005;40(1):98–102.
[2] Heck JM, Bittles MA. Traumatic abdominal aortic dissection in a 16-month-old child. Pediatr Radiol 2009;39(7):750–3.
[3] Fikar CR, Fikar R. Aortic dissection in childhood and adolescence: an analysis of occurrences over a 10-year interval in New York State. Clin Cardiol 2009; 32(6):E23–6.
[4] Mayo E, Hackworth J, Billmire D. The complex management of a traumatic brain injury and aortic injury after a motor vehicle crash: a case report. J Trauma Nurs 2014;21(1):9–13.
[5] Anderson SA, Day M, Chen MK, Huber T, Lottenberg LL, Kays DW, et al. Traumatic aortic injuries in the pediatric population. J Pediatr Surg 2008; 43(6):1077–81.
[6] Aidinian G, Karnaze M, Russo EP, Mukherjee D. Endograft repair of traumatic aortic transection in a 10-year-old–a case report. Vasc Endovascular Surg 2006;40(3):239–42.
[7] Saad NE, Pegoli W, Alfieris G, Waldman DL, Davies MG. Endovascular repair of a traumatic aortic transection in a pediatric patient. J Vasc Interv Radiol 2007; 18(3):443–6.
[8] Karmy-Jones R, Hoffer E, Meissner M, Bloch RD. Management of traumatic rupture of the thoracic aorta in pediatric patients. Ann Thorac Surg 2003; 75(5):1513–7.
[9] Milas ZL, Milner R, Chaikoff E, Wulkan M, Ricketts R. Endograft stenting in the adolescent population for traumatic aortic injuries. J Pediatr Surg 2006;41(5): e27–30.
[10] Papazoglou KO, Karkos CD, Kalogirou TE, Giagtzidis IT. Endovascular management of lap belt-related abdominal aortic injury in a 9-year-old child. Ann Vasc Surg 2015;29(2):365.e11–5.